

## **REMARKS**

### **I. Status of the Claims**

Applicants have amended claims 1, 20, and 26 to more sharply define the invention. Support for these claim amendments are found in the originally-filed claims, specification, and drawings. For example, support may be found at paragraphs [0016] - [0019]. Claims 1-8, 10, 11, 13-21, and 26 are pending in the application, claims 1-8, 10, 11, 13-20, and 26 stand rejected and claim 21 is withdrawn from consideration. The following remarks are respectfully submitted.

### **II. Rejection under 35 U.S.C. §112, second paragraph**

The Examiner rejects claims 1-8, 10-11, 13-20, and 26 under 35 U.S.C. § 112, second paragraph, as being indefinite. Specifically, the Examiner rejects claims 1, 20, and 26 because of allegedly insufficient antecedent basis for the limitation "an unreacted portion of the SiGe surface layer." Claims 1, 20, and 26 are independent claims. Claims 2-8, 10-11, and 13-19 depend from claim 1. Applicants have amended claims 1, 20, and 26 by reciting that the SiGe surface layer has an unreacted portion in contact with the substrate and a surface portion. Thus, the later recitation of the unreacted portion of the SiGe surface layer has antecedent basis. Applicants respectfully request withdrawal of the rejection.

### **III. Rejections under 35 U.S.C. §103(a)**

Claims 1-3, 15-16, 18, and 26 stand rejected under § 103(a) as being unpatentable over U.S. Patent No. 6,632,729 to Paton ("Paton") in view U.S. Patent No. 6,909,151 to Hareland et al. ("Hareland"). Claims 1 and 26 are independent claims of this group, with claims 2-3, 15-16, and 18 depending directly or indirectly from claim 1. Applicants have amended claim 1 and 26. Applicants respectfully traverse the rejection.

Under an obviousness analysis, several factual inquiries must be resolved. They include (1) determining the scope and content of the prior art, (2) ascertaining the differences between the claimed invention and the prior art, and (3) resolving the level of ordinary skill in the pertinent art. (See M.P.E.P. §2141 II.) The question of obviousness

must be resolved on the basis of these factual determinations. Office personnel must explain why the differences between the prior art and the claimed invention would have been obvious to one of ordinary skill in the art. (See M.P.E.P. §2141 III.)

Applicants submit that the differences between the prior art and the claimed invention are not obvious to one of ordinary skill in the art. Specifically, with respect to amended claims 1 and 26, Applicants submit that Paton in view of Hareland does not teach or suggest forming a SiGe surface layer on a substrate and then forming a high-k dielectric layer on the SiGe surface layer, such that, during forming of an oxide layer between the high-k dielectric layer and the SiGe surface layer, the substrate remains unreacted; i.e., an interfacial oxide layer does not form on the substrate. The Examiner references Paton as disclosing "forming a SiGe surface layer (within Si-containing substrate, col 3 lines 53-54) on the substrate." (See Office Action, page 3, first line.) Paton does not describe any operation that could be construed as forming a SiGe surface layer as claimed. While numerous substrates are described in Paton, including "Si-containing" substrates referenced by the Examiner, none are described as having a SiGe layer formed thereon prior to depositing the high-k dielectric layer. Furthermore, in contrast to amended claims 1 and 26, Paton describes the use of a Laser Thermal Annealing (LTA) process. According to Paton, the LTA process reduces the oxygen diffusion from the high-k dielectric oxide layer to the substrate and thereby limits reaction of the substrate. Thus, Paton does not describe or suggest forming a SiGe surface layer on the substrate prior to depositing the high-k dielectric layer.

Applicants remind the Examiner that "[r]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness." (See M.P.E.P §2142.) The Examiner references Hareland as disclosing "SiGe surface layer having an average Ge content less than about 10 at.%" (Office Action, page 3, fifth paragraph.) Applicants submit that Paton in view of Hareland provides no apparent reason for one skilled in the art to combine references, and Examiner's explanation that the reason is to "modify device properties such as enhancement of carrier mobility to improve device performance" fails to satisfy this

burden. (Office Action at page 3, paragraph 5.) This is particularly true in light of the teachings of Paton. Applicants submit that Paton teaches that the oxide layer formed is detrimental to the device performance. (See Paton at column 2, ll. 44-49.) For this very reason Paton describes a method of treating the substrate "which eliminates, or at least substantially reduces, oxygen out-diffusion from the high-k dielectric oxide layer resulting in deleterious formation of a layer of low-k oxidized semiconductor material . . .

(emphasis added)." (Paton at bottom of column 2 to top of column 3.) Hareland merely describes a transistor structure and a method of making that structure. As a part of making the structure, Hareland describes forming a SiGe semiconductor film 508 and a gate dielectric film 516, but does not describe forming an oxide between the semiconductor film 508 and the gate dielectric film 516 that is deposited thereon. Nothing in Hareland suggests forming an oxide layer between the semiconductor film 508 and the gate dielectric film 516, that oxidation of the semiconductor film 508 somehow protects the substrate 502 from reaction, or that forming an oxide layer between a SiGe surface layer and a high-k layer improves device performance. Therefore, nothing in either Paton or Hareland suggests to one skilled in the art a method of forming a semiconductor device as claimed. Applicants believe that for at least these reasons amended claim 1 and amended claim 26 are nonobvious over Paton in view of Hareland. Applicants respectfully request withdrawal of the rejection.

Claims 4-8 stand rejected under § 103(a) as being unpatentable over Paton in view of Hareland and in view of EP 0684 650 B1 to Hiroshi et al. ("Hiroshi"). Claims 4-8 depend directly or indirectly from amended claim 1. Applicants respectfully request that the rejection of claims 4-8 be withdrawn. The arguments presented above for amended claim 1 and 26 apply equally to this rejection. As set forth above, Paton in view of Hareland does not teach or suggest the invention claimed in amended claim 1. Hiroshi does not cure that deficiency. Accordingly, claims 4-8 are nonobvious over Paton in view of Hareland in further view of Hiroshi. Thus, withdrawal of the rejection of claims 4-8 is respectfully requested.

Claims 10 and 11 stand rejected under § 103(a) as being unpatentable over Paton in view of Hareland and U.S. Patent Application Publication No. 2003/0218189 to

Christiansen et al. ("Christiansen"). Claims 10 and 11 depend directly from amended claim 1. The arguments presented above for amended claim 1 apply equally to this rejection. As set forth above, the combination of Paton in view of Hareland does not teach or suggest the invention claimed in amended claim 1. Christiansen does not cure that deficiency. Claims 10 and 11 are nonobvious over Paton in view of Hareland in further view of Christiansen. Thus, withdrawal of the rejection of claims 10 and 11 is respectfully requested.

Claims 13-14 and 19-20 stand rejected under § 103(a) as being unpatentable over Paton in view of Hareland and in further view of Westlinder et al., *Effects of low-temperature water vapor annealing of strained SiGe surface-channel pMOSFETs with high-k dielectric*, European Solid-State Device Research, September 2003, pp. 525-528 ("Westlinder"). Claims 13, 14, and 19 depend directly from amended claim 1. Amended claim 20 is an independent claim. Applicants respectfully request withdrawal of the rejection.

Applicants submit that Paton in view of Hareland and in further view of Westlinder fails to teach or suggest the inventions of claims 13, 14, and 19 and amended claim 20. The arguments presented above for amended claim 1 apply equally to the rejection of claims 13, 14, 19, and 20. Westlinder fails to cure what Paton in view of Hareland is missing. Consequently, claim 13, 14, 19, and 20 are nonobvious over this combination of references. Further, with regard to amended claim 20, the Examiner's combination of Paton in view of Hareland and in further view of Westlinder fails to teach or suggest exposing the substrate and the high-k dielectric layer as recited in claim 20 to an oxygen-containing gas to form an oxide layer between the high-k dielectric layer and the unreacted portion of the SiGe surface layer such that the substrate remains unreacted. Applicants note that in Paton at column 2, lines 36-37 describes that oxygen diffuses "from the high-k dielectric oxide layer" into the underlying semi-conductor material. Westlinder does not help either. Please recall that the oxide layer in Westlinder is formed prior to depositing the high-k dielectric. Further, Westlinder describes water vapor annealing and there is no indication in Westlinder that the water vapor annealing oxidizes the SiGe surface layer. For example, Westlinder describes that from the C-V curves " $C_o$  is

rather constant with annealing time suggesting that no reaction has taken place among the materials in the stack." Thus, Westlinder suggests that a wet vapor annealing atmosphere does not affect, much less form, an oxide layer between the high-k dielectric layer and the unreacted portion of the SiGe surface layer, as claimed. Consequently, one skilled in the art would not reasonably expect to successfully form an oxide layer between the high-k dielectric layer and the unreacted portion of the SiGe surface layer by exposing the substrate to an oxygen-containing gas, as claimed, by combining Paton with Westlinder in view of Hareland. For at least this additional reason, amended claim 20 is nonobvious over Paton in view of Hareland and in further view of Westlinder.

Claim 17 is rejected under § 103(a) as being unpatentable over Paton in view of Hareland and U.S. Patent No. 5,259,881 to Edwards et al. ("Edwards"). Claim 17 depends directly from amended claim 1. Applicants respectfully traverse the rejection. The arguments presented above for amended claim 1 apply equally to this rejection, the combination of Paton in view of Hareland does not teach or suggest the invention claimed in amended claim 1. Edwards does not cure this deficiency. Claim 17 is nonobvious over Paton in view of Hareland and Edwards. Thus, withdrawal of claim 17 is respectfully requested.

#### **IV. Conclusion**

In view of the foregoing amendments to the claims and remarks given herein, Applicants respectfully believe this case is in condition for allowance and respectfully request allowance of the pending claims. If the Examiner believes any detailed language of the claims requires further discussion, the Examiner is respectfully asked to telephone the undersigned attorney so that the matter may be promptly resolved. The Examiner's prompt attention to this matter is appreciated.

Application No. 10/797,876  
Response dated August 4, 2008 to  
Non-final Office Action mailed June 3, 2008

Applicants are of the opinion that no fee is due as a result of this Amendment. If any charges or credits are necessary to complete this communication, please apply them to Deposit Account No. 23-3000. Payment of all charges due for this filing is made on the attached Electronic Fee Sheet. If any additional charges or credits are necessary to complete this communication, please apply them to Deposit Account No. 23-3000.

Respectfully submitted,

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